PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Shigeki ENDO, Howard SEE, Tasuku SAITO, Koji SAKATA, Kenji FUKUDA, Youichiro HARA, and Tatsuo UMENO

Rule 53(b) Divisional of Application No.: 08/921,537

Filed: March 5, 2002 Docket No.: 040055.01

For: PARTICLES FOR ELECTRO-RHEOLOGICAL FLUID

PRELIMINARY AMENDMENT

Director of the U.S. Patent and Trademark Office
Washington, D. C. 20231

Sir:

Prior to initial examination, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Page 4, lines 20 - 25, delete current paragraph and insert therefor:

Furthermore, it is preferable that particles of electro-rheological fluid, including spherical carbonaceous particles, of the present invention have physical properties such as a collapsing strength of 5 kgf/mm^2 or more, a maximum displacement amount of 3% or more, an ash content of 0.1% or less, and an average particle size of 0.1 to 20 μm.

Page 6, lines 2 - 4, delete current paragraph and insert therefor:

Fig. 1 is an electron microscopic photograph of the structure of spherical particles for electro-rheological fluid of Example 5 at a magnification of 5000x.

Page 6, line 26 - Page 8, line 23, delete current paragraphs and insert therefor:

Aromatic sulfones or condensation products of the salts used in the present invention can be easily produced in a known method. That is, in general, aromatic sulfonates or salts thereof are condensed using formalin, paraformaldehyde, hexamethylene tetramine or other aldehydes. They can also be obtained by the polymerization of aromatic sulfonate having a vinyl group such as polystyrene sulfonic acid. A polymer of aromatic sulfonic acids having a methylene type bond can also be used. As a group for linking aromatic sulfonic acids, a $-CH_2-$ group is particularly preferable because production is simple and it is easy to get. A compound having a linking group represented by $-(CH_2)_n-T_x(CHR-)_m-$ (wherein T represents a benzene ring or a naphthalene ring, R represents hydrogen, a lower alkyl group or a benzene ring, and n, m, x represent integers of 0 or 1, respectively) can be used as well. These condensation products can be a mixture of two or more kinds of condensation products or a copolymer.

As a concrete example of aromatic sulfonates or a condensation product of the salts, a formaldehyde condensation product of β-naphthalene ammonium sulfonate can be presented. The condensation product is a mixture of compounds ranging from monomer units to condensation products of up to about 200 units. The average molecular weight is about 2,000 to 5,000. It is solid at ordinary temperatures and dissolves very feebly in nonpolar solvents such as benzene, but dissolves in low concentrations in polar organic solvents such as acetone and acetonitrile and dissolves in aqueous solvents easily. The viscosity of a 40% by weight aqueous solution thereof at 20°C is about several dozen to several hundred centipoise. By changing the condensation degree or the solution concentration of the condensation product an appropriate viscosity can be reached. In this way the condensation products can be made spherical.

As a forming auxiliary agent, various polymer compounds soluble or capable of being dispersed as a colloid in water or an aqueous solution can be used. As the forming auxiliary agent, water-soluble polymer compounds including polyalkylene oxide compounds such as a condensation product of ethylene oxide and propylene oxide, or a condensation product of these and alcohol, aliphatic acid, alkyl amine, and alkyl phenol; polyvinyl compounds such as polyvinyl alcohol and polyvinyl pyrrolidone; and polyacrylic acid compounds such as polyacrylic acid, polyacryl amide, and acrylic acid-acrylic acid copolymer can be used. Further, a surfactant or an antifoaming agent for decreasing the surface tension can be used together for facilitating the formation. A dried and pulverized formaldehyde condensation product of β-naphthalene ammonium sulfonate can be used to adjust the viscosity to an appropriate degree. Aromatic sulfonic acids and polystyrene sulfonic acids, which are one type of condensation product of the salts thereof, of the present invention can be used as a water-soluble polymer as well.

Page 9, line 19 - Page 10, line 8, delete current paragraph and insert therefor:

The particles for an electro-rheological fluid of the present invention must be spherical. The term "spherical" used herein denotes that particles observed with an electron microscope are spherical. Preferably, both the deviation of the maximum diameter of a particle and the deviation of the minimum diameter of the particle are within 30% of the average diameter, more preferably within 20%. The bumpiness, of the surface gap, in a theoretical particle with an ideal smooth spherical shape, is preferably 10% or less with respect to the average diameter, and more preferably 5% or less. Most preferably, the deviation of the maximum diameter of a particle and the deviation of the minimum diameter of the particle are within 10% of the average diameter, and the bumpiness, of the ideal spherical surface gap, is 3% or less with respect to the average diameter. The term "the

average diameter" of one particle used herein refers to the average value of the maximum diameter and the smallest diameter of the particle.

Page 11, line 17 - Page 12, line 9, delete current paragraphs and insert therefor:

The heat treatment temperature in the carbonizing treatment process must be in the range of 400 to 600°C, particularly preferable is 450 to 550°C. The heat treatment can be conducted twice or more. With a temperature lower than 400°C, sufficient electro-rheological characteristics are hard to obtain due to residual impurities such as S, O, and N in the obtained carbonaceous particles. With a temperature higher than 600°C, the electrical resistance of the treated particles becomes low, and the power consumption increases due to the excessively large electric current necessary. Problems such as heat generation at the time of voltage application also arise. Therefore, neither is preferable.

In the carbonizing treatment of a condensation product of ammonium salt of aromatic sulfonic acids, since sulfurous acid radicals and ammonium radicals are eliminated mainly in the range of 250 to 350°C, in order to prevent strength deterioration caused by rapid elimination of volatile components, it is preferable to raise the temperature to the temperature range of 250 to 350°C gently, or to set the time for maintaining this temperature range.

Page 13, lines 2 - 12, delete current paragraph and insert therefor:

Furthermore, it is preferable that the carbonaceous particles have a collapsing strength of 5 kgf/mm^2 or more, and a maximum displacement amount of 3% or more. These can be measured with a micro-compression tester capable of measuring the strength of each particle (such as MCTM series produced by Shimadzu Corporation) as disclosed in examples. If the collapsing strength is less than 5 kgf/mm^2, the strength with respect to particles break-up is insufficient, and when acting as a damper being repeatedly treated to shearing stress, durability lowers. The preferable collapsing strength range is 10 kgf/mm^2 or more.

Page 15, lines 15 - 21, delete current paragraph and insert therefor:

The initial viscosity and the viscosity of the electro-rheological fluid with an electric field of 2 kv/mm applied, and the electric current density of the electro-rheological fluid with an electric field of 2 kv/mm applied were measured with an RDS-II type rheometer produced by RHEOMETRICS Far East Co., Ltd., at room temperature (about 25°C) and at a shear rate of 366/second.

Page 19, line 23 - Page 20, line 4, delete current paragraph and insert therefor:

Fig. 1 is an electron microscope photograph of spherical particles for electro-rheological fluid of Example 5 at a magnification of 5000x. The particles are observed to be spherical particles having a smooth surface. That is, the deviations of the maximum diameter and the minimum diameter of the obtained particles with respect to the average diameter were within 10%, and the surface bumpiness thereof was within 3%, respectively.

REMARKS

The attached Appendix includes marked-up copies of each rewritten paragraph (37 C.F.R. §1.121(b)(1)(iii)).

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Joel S. Armstrong
Registration No. 36,430

JAO:SXT/kaf

Date: March 5, 2002

OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400

DEPOSIT ACCOUNT USE AUTHORIZATION
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APPENDIX

Changes to Specification:

Page 4, lines 20 - 25:

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